17. (amended) the method as claimed in any one of claim 1 to 5, the seed single crystal of the step (a) has a plate-shape or inverted L-shape.

Delete claim 15 in favor of the remaining claims.

**REMARKS**

The Official Action of September 23, 2002, has been carefully reviewed. The claims in the application are now claims 1-14 and 16-23. Applicants note that no rejections have been imposed on the basis of any prior art, and applicants accordingly understand that all of applicants' claims are deemed by the PTO to define novel and unobvious subject matter under §§102 and 103.

Further in this regard, applicants wish to make of record a telephone call from the examiner only a few days before the mailing date of the Office Action on September 23, 2002, the examiner at that time indicating to undersigned that the present application was essentially in condition for allowance, it being only necessary to make some minor changes, one in claim 10 and another in claim 17. As these changes did not affect the scope of the claims, i.e. they are not narrowing amendments, with the meaning of the claims remaining the same, undersigned agreed on behalf of applicants, and the

examiner indicated that he would make the changes by Examiner's Amendment.

Instead, the Office Action issued. Applicants believe that the examiner was previously correct, and that the Office Action should not have been issued.

As applicants' invention defines patentable subject matter, applicants respectfully request favorable consideration and early formal allowance.

Acknowledgement by the PTO of the receipt of applicants' papers filed under Section 119 is noted.

Applicants note the drawing criticisms made by both the examiner and the Official Draftsman. As indicated above, prints of certain of the drawings sheets marked in red to show proposed changes are attached. These changes in part address both the examiner's requirements and those of the Official Draftsman (paragraph 6 of the form PTO 948).

Typically, drawings are submitted with mechanical and electrical inventions, but often not with chemical inventions. The reason why drawings are submitted in mechanical and electrical inventions is that they are necessary for the understanding of the subject matters sought to be patented. The drawings submitted with mechanical and electrical inventions generally show constructions of the

relevant inventions and prior art. Therefore, it is appropriate to designate "Prior Art" in the drawings relating to prior art constructions to distinguish such prior art from the relevant inventions. However, drawings of chemical inventions are mostly graphs, microscope photographs or electrophoresis photographs, which show effects, not constructions. In these cases, it may sometimes be inappropriate to distinguish between prior art and the relevant inventions by designating "Prior Art" in some of the drawings.

The drawings of the present application also relate to the effects (results) of these inventions except for Fig. 1. However, the results are divided into two different groups. One group relates to results obtained by carrying out a more critical part of the invention, i.e. observation results of abnormal grain growth under a specific condition which may be the condition set forth in claim 1 (e.g. Figs. 2,3,4,5, 9 and 12), and the other group relates to results obtained by carrying out the entire invention (e.g. Figs. 6,7, 7, 10-11, and 13-16). Therefore, applicants submit it is not appropriate to designate as prior art all of the drawings that the examiner pointed out as being prior art. **Applicants would like to designate only a part of the drawings, i.e. Fig. 2(a), Fig. 4, Fig. 9(a) and Fig./ 12(a) by the term "Prior Art"**

because these drawings relate to the cases in which abnormal grain growth does not occur.

In Fig. 2(b), Fig. 3, Fig. 9(b) and Fig. 12(b), however, one can see that abnormal grain growths occur successfully in the PMN-PT, PZT polycrystal, which the inventors believe that they are the first to have observed or discovered. The inventors think no one had ever shown abnormal grain growths in PMN-PT and PZT polycrystal until the priority date of this application. Therefore, the above-listed drawings should not be designated by "Prior Art".

Fig. 5 and Fig. 6 relate to experiments conducted to demonstrate the fact that PMN-PT single crystal of MPB composition grows effectively under the condition of the excess addition of both MgO and PbO, which are specific components of the polycrystal. The inventors believe that they first discovered this fact. Fig. 5 is to demonstrate how the condition of the excess addition of both MgO and PbO influences the abnormal grain growth in PMN-PT polycrystal. Therefore, applicants submit that Fig. 5 and Fig. 6 should not be designated "Prior Art".

Most of all Fig. 6(b) clearly relates to the results of a preferred example of the present invention because a seed crystal is adjoined to a polycrystal, which appears from the

Office Action to have been accepted by the examiner as a drawing showing this invention, not prior art.

Applicants respectfully request approval of the limited number of figures marked "PRIOR ART" as attached.

Claim 1 has been rejected under the first paragraph of §112. The rejection is respectfully traversed.

Respectfully, applicants do not understand the rejection or its basis, as perovskite crystal structures are well known. It is fundamental in patent law that an inventor need only start where his invention begins, and it is not necessary for an inventor to tell the art everything the art already knows.

The term "seed" does not mean any special crystal in the specification. The word "seed" is used in the specification only to indicate an origin which induces grain growth. In other words, "perovskite seed single crystal" of claim 1 means a perovskite oxide having a single crystal structure and serving as an origin of grain growth. The meaning of the term "perovskite oxides" is sufficiently explained in the specification. Please see page 1, lines 20 *et seq*:

> The "perovskite oxides" as used herein have a chemical formula of "$ABO_3$", e.g., Ba $TiO_3$. In Pb-type perovskite oxides, Pb substitutes for entire or a portion of "A"

> of the above formula, e.g., "$(Pb_xA_{1-x})BO_3$" ($0 \leq x \leq 1$) of a simple form or "$Pb_xA_{1-x}$) $(B_yC_{1-y})O_3$" ($0 \leq x \leq 1$; $0 \leq y \leq 1$), in which the number of the atoms substituting for "A" or "B" increases. Pb-type perovskite oxides include $PbTiO_3$(PT), (Pb, Ba)$TiO_3$, $Pb(Zr_xTi_{1-x}O_3$(PZT), $Pb(Mg_{1/3}Nb_{2/3})O_3$ (PMN), (1-x)PMN-xPT, (1-x-y)PMN-xPT-yPZ, $Pb(Zn_{1/3}Nb_{2/3})O_3$ (PZN) or (1-x)PZN-xPT, (1-x-y)PZN-xPT-yPZ, etc.

According to the above description, **the seed single crystal includes $PbTiO_3$(PT), (Pb,Ba)$TiO_3$, $Pb(Zr_xTi_{1-x})O_3$ (PZT), $Pb(Mg_{1/3}Nb_{2/3})O_3$ (PMN), (1-x)PMN-xPT, (1-x-y)PMN-xPT-yPZ, $Pb(Zn_{1/3}Nb_{2/3})O_3$ (PZN) or (1-x)PZN-xPT, (1-x-y)PZN-xPT-yPZ, etc. Therefore, the seed single crystal is not absolutely limited to Barium Titanate, and those skilled in the present art, after reading applicants' specification, would easily practice applicants' invention with perovskites other than that of Barium Titanate, with no (or at more only routine) experimentation.**

According to page 9, lines 11-18 of the specification, if a perovskite seed single crystal is adjoined to a perovskite polycrystal and then heated, the same structure as the seed single crystal continues to grow in the polycrystal. In other words, a single crystal produced by this method has the **same** chemical composition as the polycrystal and the same structure as the seed. Therefore, the chemical composition of the seed is not a critical point

for producing a single crystal, and accordingly the seed is not limited to Barium Titanate, and **any perovskite oxide can be the seed only if it has a single crystal structure.**

Applicants respectfully request withdrawal of the rejection.

Claim 15 has been rejected under the first paragraph of §112. This rejection is respectfully traversed.

Nevertheless, the rejection is no longer applicable as applicants have deleted claim 15 above, without prejudice, and without deleting the invention thereof. Claim 15 is a dependent claim, and therefore its subject matter is encompassed by the claims from which it previously depended. As regards enablement, it is applicants' position that those skilled in the art, after reading applicants' specification, would be enabled to practice the subject matter of claim 15.

Claims 1, 8, 10, 11, 12, 13, 16 and 17 have been rejected under the second paragraph of §112. These rejections are respectfully traversed.

Applicants believe, consistent with the aforementioned telephone conference with the examiner, that the claims as previously drafted, considered in light of applicants' specification (consistent with the law), would not have been confusing to those skilled in the art, and therefore

the claims in their previous form are fully in accordance with §112. At worst, some of the claims in their previous forms might be considered objectionable, but **only** as to form.

Nevertheless, in deference to the examiner's views and to avoid or minimize needless argument, a number of cosmetic amendments have been made. The amendments are of a formal nature only, i.e. made to place the claims in better form consistent with what the examiner presently considers consistent with U.S. practice. The amendments are not "narrowing" amendments because the scope of the claims has not been reduced. No limitations have been added and none are intended; the meaning of the claims remains the same.

For the record, however, many of the formal criticisms raised are believed to be inconsistent with MPEP 2173.05(e), especially the last part of the first paragraph citing *Ex parte Porter*, 25 USPQ2d 1144, 1145 (BPAI 1992) and the sentences which follows such citation. This comment applies to the recitation "the combination" criticized in claim 1, for example. nevertheless, "the combination" has been changes to "a combination".

As regards paragraph 6 and claim 8, applicants respectfully reiterate that the term "seed" does not mean any special crystal in the specification. The word "seed" is used in the specification only to indicate an origin which induces

grain growth. In other words, "perovskite seed single crystal" of claim 1 means a perovskite oxide having a single crystal structure and serving as an origin of grain growth.

If a seed single crystal continues to grow into a polycrystal (perovskite oxides), the polycrystal will finally become a single crystal. As described in the specification (page 9, lines 15-18), the newly created (or grown from the seed) single crystal has the same chemical composition as the polycrystal (i.e., perovskite oxides). The newly created single crystal meets the requirements for a seed crystal of the present invention because the new crystal is perovskite oxide and has single crystal structure. Therefore, the new crystal can be the seed crystal of the present invention, which can be repeated.

Regarding the statement in the rejection that the seed is required as a material ingredient, the chemical composition of the newly created crystal (i.e., the new seed) is clearly identical with that of the polycrystal from which the new seed was grown. Therefore, applicants do not have to recite the chemical composition separately again.

With regard to paragraph 7 and claim 10, applicants respectfully note that there are many thousands[1] of U.S. patent

[1] A quick search in the USPTO full text database has revealed 480,472 patents having claims in which the word "predetermined" exists.

claims which include the verb "predetermined". Nevertheless, the term has been eliminated in deference to the examiner's views.

Applicants respectfully submit that their claims were and are in good form, and respectfully request withdrawal of the rejection.

All issues having been resolved, applicants respectfully request favorable consideration and early formal allowance.

Respectfully submitted,

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Version with Markings to Show Changes Made

1. (amended) A method for growing single crystals of perovskite oxides, which show abnormal grain growths by means of heating, the method comprising the steps of:

(a) having a perovskite seed single crystal adjoined to a perovskite polycrystal; and

(b) heating ~~the~~ a combination of the seed single crystal and the polycrystal to ~~provide a continuous growth of the same structure as~~ have the seed single crystal ~~in~~ grow into the polycrystal, the heating being carried out under the condition that abnormal grain growths are induced at the interface between the polycrystal and the seed single crystal and are repressed inside the polycrystal.

5. (amended) the method as claimed in claim 1, wherein the heating of said step (b) is carried out under the condition that additives for promoting abnormal grain growths are locally added to ~~the~~ a combination of the seed single crystal and the polycrystal.

8. (amended) The method as claimed in any one of claims 1 to 5, wherein the seed single crystal of ~~the~~ step (a) is ~~the~~ a perovskite single crystal produced by ~~the~~ said ~~methods~~method.

10. (amended) the method as claimed in any one of claims 1 to 5, further comprising the step of:

prior to the step (a), ~~predererming~~ determining the crystal orientation of the seed single crystal, grinding a specific crystal face of the seed single crystal in the crystal orientation determined, and adjoining the ground seed single crystal to the polycrystal to determine the crystal orientation of a single crystal to be grown into the polycrystal from the seed single crystal.

11. (amended) The method as claimed in any one of claim 1 to 5, further comprising the step of:

prior to the step (a), molding the polycrystal powder ~~to a desired shape or processing the polycrystal into a complex shape~~or processing the polycrystal into a specific shape which is intended as a final shape, and then adjoining the shaped polycrystal to the seed single crystal, to produce a single crystal having ~~a desired~~said final shape without a separate step for processing of the single crystal.

12. (amended) The method as claimed in any one of claims 1 to 5, further comprising the step of:

prior to step (a), preparing a polycrystal having a ~~different~~ specific porosity, pore size and pore shape by adding an additive to the polycrystal, and changing the amount

of a liquid phase or the sintering temperature, atmosphere or pressure of the polycrystal, to control the porosity, the pore size and shape in the single crystal to be grown in the polycrystal~~, thereby preparing perfectly dense single crystals destitute of pores or single crystals having various porosities~~.

13. (amended) The method as claimed in any one of claims 1 to 5, wherein the perovskite polycrystal of the step (a) is the polycrystal having a composition gradient that changes discontinuously or continuously by adding one or more selected from the group consisting of ~~solutes to be solved~~ BaO, $Bi_2O_3$, CaO, CdO, $CeO_2$, CoO, $Cr_2O_3$, $Fe_2O_3$, $HfO_2$, $K_2O$, $La_2O_3$, MgO, $MnO_2$, $Na_2O$, $Nb_2O_5$, $Nd_2O_3$, NiO, PbO, $Sc_2O_3$, $SmO_2$, $SnO_2$, SrO, $Ta_2O_5$, $TiO_2$, $UO_2$, $Y_2O_3$, ZnO, and $ZrO_2$ into perovskite structures to the perovskite polycrystal.

16. (amended) the method as claimed in any one of claims 1 to 5, the perovskite polycrystal is characterized in that one or more additives selected from the group consisting of BaO, $Bi_2O_3$, CaO, CdO, $CeO_2$, CoO, $Cr_2O_3$, $Fe_2O_3$, $HfO_2$, $K_2O$, $La_2O_3$, MgO, $MnO_2$, $Na_2O$, $Nb_2O_5$, $Nd_2O_3$, NiO, PbO, $Sc_2O_3$, $SmO_2$, $SnO_2$, SrO, $Ta_2O_5$, $TiO_2$, $UO_2$, $Y_2O_3$, ZnO, and $ZrO_2$ to ~~be solid-solved~~form a solid solution into perovskite structures are added to the polycrystal.

17. (amended) the method as claimed in any one of claim 1 to 5, the seed single crystal of the step (a) has a plate-shape or ~~"¬"-shape~~inverted L-shape.